



*Citation for published version:*

Burrows, R, Johnson, H & Johnson, P 2013, *Influencing Values, Attitudes and Behaviour via Interactive and Social-Media Technology: The Case of Energy Usage* . Department of Computer Science, University of Bath, Bath, U. K.

*Publication date:*  
2013

[Link to publication](#)

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# Influencing Values, Attitudes and Behaviour via Interactive and Social-media technology: The Case of Energy Usage (Technical Report)

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## ABSTRACT

Reducing our carbon footprint is an urgent global issue. What role can interactive and social-media technologies play in addressing this challenge? How can these technologies be used to influence people to change their energy-usage behaviours? Existing solutions report limited and only short-term success due to the difficulties of making the information personalised and contextually relevant and in focusing upon behaviour rather than the values governing behaviour. The first of these issues is difficult due to the considerable variability in the lifestyles of different people and communities. The second is difficult because of the problems of identifying people's values and relating these to energy behaviours. This paper investigates how to overcome these two difficulties by considering these issues, developing five principles relating values to influences upon behaviour change, presenting an architecture for design and reporting empirical studies that show the implications for the design of influence technologies. The empirical studies, a diary study and focus group, qualitatively evaluate how people can be influenced in making decisions about energy use behaviours.

## INTRODUCTION

Reducing our carbon footprint is an urgent global challenge. An important factor in addressing this challenge is people's attitudes and behaviours to using renewable sources of energy and adopting energy sustaining lifestyles. A significant contribution to influencing people's attitudes and behaviours can be made by understanding how information and knowledge can be created, collected, represented, shared and used by both individuals and communities to help them address this challenge.

In this research the concept of "influence" is preferred as opposed to "persuasion". Consequently, a primary research aim is to develop interaction and social-media technologies that *influence* and support pro- environmental values, attitudes and behaviours towards energy usage and carbon reduction [10]. In

trying to influence people both "carrots" and "sticks" are used to encourage and/or prevent and punish people for the actions they take. People's behaviours may be changed in the short-term but longer term they revert to their existing behaviours. Encouragement and support leading to self discovery results in lasting, longer term influences on people's attitudes and behaviours.

Many existing approaches use interactive technologies to influence people's behaviour by providing feedback on their energy consumption data to allow them to understand and compare the costs of different usage profiles e.g.[9, 11, 17]. Others aim to promote pro-environmental values and attitudes in the hope that this will influence people's choices and decisions in favour of more sustainable behaviours [22, 27]. Yet other approaches try to use social-media to influence an individual's attitudes and behaviours such as by sending pro-environmental messages between groups of people [16, 15] (or sometimes between software agents and people [12, 20]).

However, there remain many ethical, theoretical and technological challenges facing the use of interactive technologies and social-media to influence people's behaviours. Persuasive technologies are in danger of forcing people to conform to expected behaviours and targets without understanding why particular people's behaviours are being carried out. Consequently, many case studies report limited success and a lack of long-term engagement e.g.[26, 18]. Evidence suggests that long-term behaviour change is not achieved through such an approach. Instead people ignore or find workarounds to overcome the imposed barriers [3, 7].

These challenges are difficult to overcome due to the complexity and lack of understanding about what leads to the variability between people's values, lifestyles and behaviours. Hence, a one-size-fits-all approach is likely to be unsuccessful [3, 13]. Consequently, the types of influences that are appropriate and effective are likely to be highly personalised. Hence there is a need to understand what influences people's decisions and choices leading to their energy-related activities and how to effectively make use of interactive and social-media technologies to exert influence on these decisions and behaviours.

This paper addresses the following questions:

- What influences people to adopt lasting energy sustaining values and behaviours?

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- What are the implications for how we use interactive and social media technologies to exert influence on these values and behaviours?

The contributions of the research are: First, the development of a set of principles for influencing behaviour. Second, the derivation of an architecture for design from these principles. Third the results from a photo diary study to understand individual and common properties of peoples lives and their values. Fourth, the results from a focus group to provide a qualitative evaluation of how people's values and lifestyles influence their decisions and actions about energy use. Finally, the implications for the design of interactive and social media technologies to influence people's decisions and behaviours.

In the remainder of this paper we give an overview on the key drivers of energy use and persuasive technologies, discuss the setup of our diary study and focus group, present the results and analysis, and finally, discuss the implications for tool design.

## **VALUES, INFLUENCE, ENERGY USE AND EXISTING PERSUASIVE TECHNOLOGIES**

Next, consider the relevant current research on the important role of values in behaviour change and the design of persuasive technologies.

### **Values and influence**

People's decisions and behaviours are very much influenced by the values that they hold. A value is something that an individual or group of people see as an important aspect of their life. Values are used to select and justify actions and to evaluate people (including the self), artefacts and events [21].

The values people hold are considered as important influencers and drivers for their specific energy related behaviours [14, 19]. Those values may be articulated in rather generalised forms by collective terms [21]. However, they take on real meaning and influence at a much more personal and individual level. Moreover, the values for an individual are constructed and operationalised in the terms and contexts of their everyday lives. Hence the concern is with understanding how the values that individuals hold and practice in their everyday lives influence their energy usage and how through recognising and supporting those people's values will enable us to influence and support them in adopting energy conservation behaviours. Understanding how those individualised and particularised values and behaviours relate to the wider group and community values and behaviours, enable us to investigate how to enable a collective approach to sustainable energy behaviours, where individuals explore and share strategies, information, knowledge, for supporting their everyday life values while developing energy sustaining behaviours.

Individuals and communities often face conflicts and tensions in the decisions they must make to adhere to the different values they hold. For instance, there may be conflicts between their values towards being comfortable within their home, their home security and their health that influence their decision about opening or closing windows. In other words, values guide our everyday choices, decisions and behaviours, at least

some (if not many) of which may directly or indirectly affect energy use.

Research in psychology and sociology has shown the importance of motivating behaviour change by communicating information in ways that is relevant and takes into account peoples values. Within the HCI field, these theories have influenced the design of tools by motivating behaviour change through persuasive interfaces. For instance, work by Sheppard et al [22] creates visualisations to support decision making within communities. They appeal to people's value of their locality and environment by showing the impact of climate change on the surrounding landscape.

### **Drivers to the design of existing persuasive technologies**

Many persuasive technologies aim to reduce energy demand by supporting pro-environmental behaviours e.g. [5, 11, 12, 17]. They capitalise on the use of technology to deliver behaviour change interventions. Such tools vary greatly in their design and are often based on popular theories of behaviour change, such as the behavioural model of rational choice [24], value-belief-norm model [25] or action-behaviour-choice [23]. These models allow for designers to get a better understanding of what message needs to be presented to the user, and the message framing. In particular, these solutions differ on the information they know about the user and their approach to persuading a reduction in energy use. However, this information needs to be relevant and meaningful within the context of a users lifestyle, otherwise people will ignore or work around the imposed barriers [6, 7, 22].

Approaches using interactive technologies have considered different ways in which we can collect and monitor energy-use and provide feedback to households or building users [11, 17]. Computer science and building simulation research often utilise predictive modelling and simulation techniques to calculate potential energy saving opportunities at certain time periods, e.g. alternative home heating and cooling programs. This allows people to weigh up the energy costs and benefits of certain usage scenarios and change behaviour by selecting cheaper scenarios. Solutions that solely focus on sensing and predicting (or blindly curtailing) user behaviour are in danger of forcing people to conform to expected efficiency targets without understanding why particular behaviours are being carried out. As such, case studies report limited success and a lack of long-term engagement [3].

Other approaches aim to promote pro-environmental values and attitudes in the hope that this will influence our choices and decisions in favour of more sustainable behaviours [22, 27]. Despite this, a person holding a particular value or attitude does not necessarily act upon it [14, 23, 1]. There is therefore a need to take into account the complex decision making processes and trade-offs that take place which result in energy-related activities. These will in turn help researchers to understand barriers to behaviour change.

A third approach involves the use of social influence. Some tools communicate pro-environmental messages between groups of people [15, 16] (or sometimes between software agents and people [12, 20]) aiming to influence attitudes or

behaviours. Unfortunately, it is difficult to understand which types of messages or information is likely to have a significant impact on communities. A recent survey noted that about 70% of persuasive technologies are designed for interactions with one user only [8] meaning there is less understanding about effective strategies on how we use technology to influence communities to change behaviour.

### VALUES, PRINCIPLES AND ARCHITECTURE

This section discusses how understanding values can be used to influence behaviour change in favour of sustainable behaviour. Through identifying the values of individuals and communities and also through how those values shape their attitudes and behaviours, interactive and social-media technologies can then help them maintain their values while enabling them to discover their own behaviour changes. Yet, there is still a lack of research into how to understand what those values are, how those values are associated with specific behaviours of individuals and communities and how interactive and social media technologies can influence those behaviours.

From a position of understanding the relationships between values, attitudes and behaviours, discussed above, a number of principles can be made.

### Principles for influencing behaviour through interactive and social media technologies

Drawing from existing literature on values, attitudes and influencing behaviour change, five principles of influence are proposed to motivate behaviour change and are related to energy usage behaviours. From these principles, an architecture for the design of interactive and social media technologies is derived.

*Principle 1:* Influences should support continuance of a highly valued aspect of a persons life that may be either directly or only indirectly related to energy. The hypothesised outcome is that by supporting the highly valued aspect of their life to motivate behaviour change then they adopt the changes and they change their energy usage behaviour.

*Principle 2:* If the influence violates the high value aspect of a persons life this may result in negative energy consequences.

*Principle 3:* An influence to motivate behaviour to energy consumption that directly relates to a high value aspects of a persons life change must have a positive or a neutral effect on the high value aspect.

*Principle 4:* A high value aspect of a persons life can be used as a vehicle to influence through support, encouragement, and motivation the behaviour change consequence.

*Principle 5:* A high value aspect of life that a person and a community have in common can be used to influence and motivate the community and the individual in the community. This can be achieved through the creation of social norms, knowledge sharing, community decision-making, and in-turn this can be facilitated via social media.

### Architecture for the Design of Influencing Interactive and Social Media Technologies

This section presents an architecture derived from the above principles and composed of elements that are necessary to create, use and interact with information and support energy sustaining behaviours. Figure 1 shows the relationships between these elements and how they may be composed within an interactive tool that influences behaviour change.

The purpose of presenting this architecture is to demonstrate how the principles can be used to design and use interactive and social-media technologies to influence behaviour change.

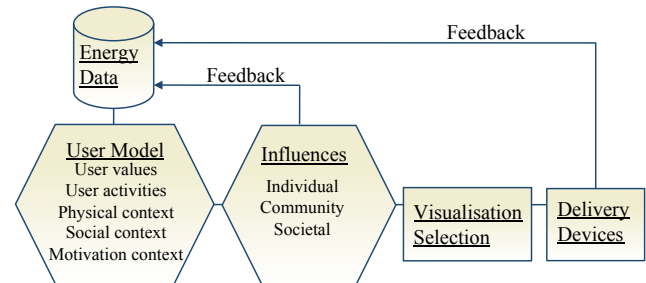


Figure 1: Architecture for Intervention Delivery

The Energy Data component is a repository for knowledge, information, and data collected, created, used and interacted with by the system and its user(s). It contains data about the users energy usage collected with the users permission and on their behalf. It also contains data that other users in the community and wider society are prepared to share with the user on their energy usage information. It is updated continually, it allows energy usage to be related to behaviour strategies and to values (via the user model) so that users can receive tailored information on the effects of their behaviour strategies on their energy usage and the effects of their energy usage on their values. It will allow for the system to evolve and learn from past interventions. The User Model contains information about important features of the user(s) values, their energy related activities (e.g. working, entertaining etc), the physical context that the user is currently in (where in the home, the vehicle, etc), the social context they are in (e.g. alone, with family, friends, work colleagues etc) the motivational context (e.g whether the user is highly motivated towards a particular value at that moment etc) this information is created by the user and the system through co-learning so that the systems learning about the user can be tailored and corrected by the user.

The user model and the energy data model interact to produce relationships between user properties and energy usage for the user to inspect and modify. The Influence model contains detailed knowledge about user(s) values and their priority. In addition it contains knowledge of the user(s) community values and the user(s) wider societal values. It uses this knowledge to produce tailored advice and information to the user about the relationships between their particular values and energy usage. In addition it draws on the community and society values knowledge together with the shared community and wider society energy data to provide the user with support and

advice drawn from the community and wider society. The Visualisation Selection component subsequently personalises influences for different users and generates a representation appropriate to the device on which it is to be displayed. The Delivery Devices component represents the technology used to convey the representation and is used to ensure that the users interaction with the represented data, information and knowledge provided is of the highest and most usable quality for the device.

The architecture allows individual energy behaviour to be related to individual values while drawing on community and societal energy behaviours and values to provide advice and support. It allows for example for the case where the same energy intensive behaviour may be performed by individuals holding different values. Therefore, to influence a change to behaviour for each person may require different motivations, advice and supports. Likewise, two people holding similar values may have very different lifestyles and as such the intervention may be motivated in the same way, yet the behaviour changes may be different.

## STUDY

The study aim is to gain an in-depth understanding about how knowledge of peoples values, behaviour, and energy use can be used in the design of interactive and social media technologies to influence people's behaviours. We conducted a photo diary study and focus group in order to understand how everyday activities are coordinated and the driving factors to key energy-related decisions in peoples lives. The study had three objectives:

*Objective 1: Values* The first objective was to understand values. The study was designed to identify what values govern everyday life, identify commonalities and differences in values, and also identify the relationship between these values for individuals and groups.

*Objective 2: Relating Values to Behaviours* The second objective was to understand how these identified values are related to specific behaviours for individuals and as a group.

*Objective 3: Tensions between values and consequences for behaviour change* The third objective was to understand the tensions between values and behaviours, how people's values and lifestyles influence their decisions and behaviours related to energy use, and the consequences upon valued aspects of lifestyle if energy use was constrained.

### Study part one: photo study

A photo diary study[4] was conducted to understand about what people valued in their everyday lives, contributing to objectives one and two of the study. 21 Participants took a selection of photos that represented activities, events or scenarios of things that were of value, everyday and routine, important and exceptional. Photo diary studies have been widely used in social science research and in ecological studies in computer science [2, 4] Table 1 provides details about the 21 participants who completed the study.

After conducting a pilot with 2 participants to calibrate the number of photos requested and length of time given, a further

	<25	25-44	45-64	65+	Total
Student	4	0	0	0	4
Employed Prof.	0	6	1	0	7
Employed Non-Prof.	0	3	2	0	5
Retired	0	0	4	1	5

Table 1: Sample: age vs profession

19 participants were each given a disposable camera to take 10 photographs over a period of 1 week and were paid £10 on return of the camera. Participants were also given a caption form to describe the time each photo was taken, the contents, and the reasons why it was of value and included in the set.

Both the written captions and photo representation were useful in understanding everyday life. The caption provided a literal description of the aspect of value, yet the photo depicted different representations and revealed more about the context in which the photo was taken. The photo contents were used to reconstruct events to gain a better understanding of values, behaviours and their relationship to every day life.

Photos could be taken at any point in time chosen by the participant meaning each photo was event-contingent. This allowed for photos to be taken when opportunities arise to capture specific activities. For instance, if an exceptional activity occurs, this may be overlooked if times for capture were prescribed. This freedom enabled the variance of lifestyles to be recorded.

### Study Part Two: Focus Group

Subsequently to the photo diary, a focus group was conducted to expand upon the results from the photo diary study in terms of understanding values and behaviours, but also to understand the tensions that exist between them and the consequences this has upon influencing behaviour change. The focus group addressed all three objectives.

Participants were not told that the photo study nor the focus group related to energy or behaviour change until values and relations were known. Hence the initial tasks relating to values and behaviours could be completed without any bias of saving energy. Only in the latter part of the focus group (task 5 onwards) were connections drawn between values, behaviours and energy use and implications for influencing behaviour change made. A pilot focus group was conducted with 2 participants, following this the full-scale session was conducted over 3 hours with 6 participants who were paid £35 Amazon voucher for their time.

#### Individual Values and Behaviours (focus group tasks 1-3)

Tasks 1-3 were designed to identify what values govern everyday life and identify the relationship between these values and behaviours. Task 1 participants were each asked to revisit and talk about why their 10 photos were chosen. This allowed participants to recall why they included each photo in their set, see the photos of other participants, and to hear about the individual and different aspects of life they valued.

Tasks 2 and 3 prioritised and weighted the photos to show which were the most valued aspects of everyday life. Participants sorted the photos in order of what they value the most

(Task 2) and divided 100 points between their 10 photos, according to what they valued the most (Task 3).

#### Group Values and Behaviours (focus group task 4)

Task 4 was designed to identify commonalities and differences in values and behaviours within the group. Participants categorised the photos by grouping photos that are related and labeled each category. This task was completed individually and then participants discussed and merged their individual categories into one final set of categories they agreed.

#### Tensions, Trade-offs and Energy-use (focus group task 5-7)

Task 5-7 explored tensions between values and behaviours. Trade-offs and tensions revealed by participants show how to personalise ways of influencing behaviour for individuals and groups. In particular, the next tasks explore how peoples values shape their behaviours related to energy use, and the trade-offs that are made between valued aspects of lifestyle if energy use was limited.

Tasks 5 and 6 displayed the value categories agreed from Task 4 across two whiteboards as shown. The purpose of this task was to indicate how participants would prioritise energy use across values and activities when viewing energy as a limited resource they could spend and save. Each participant was given two sets of 12 post-it notes. On the first whiteboard 12 post-it notes were stuck under the corresponding category names according to where participants would *spend* energy (Task 5). On the second whiteboard, 12 post-it notes were stuck under the corresponding categories according to where participants would *save* energy (Task 6).

Task 7 was a discussion into the implications of the lifestyles of each participant on energy use. Specific topics were covered such as which aspects of everyday would participants change if energy was limited, what alternatives would they choose and what participants would do today if today were the day to conserve energy.

## RESULTS AND ANALYSIS

This sections reports on the results from the photo diary study and focus group. The photos captured spanned a range of activities of everyday life including work, play, leisure, social and typical activities of daily living. They represented things that were routine, important, exceptional and of value as specified in the instruction sheet. Table 2 shows example results from three of the photos from participant 1 above their associated captions explaining the photo contents and a justification to why it was chosen. The following sections discusses the results from the focus group tasks involving 6 participants from the photo diary study. Tasks 1- 4 addressed objectives 1 and 2 while tasks 5-7 addressed objective 3.

#### Individual Values and Behaviours (Task 1-3)

In Task 1 participants revisited each photo using it as a cue to discuss the activities and events surrounding each photo. Often, the object of focus did not represent an item of value but was used to convey value or importance of an associated activity, event or scenario.

		
<b>Evening Meal</b> "Keeps our strength up. One eaten, 2 in freezer - always a ready meal."	<b>Washing</b> "Cold blowy day, dries quicker outside. It always needs doing"	<b>My Phone</b> "Used Everyday Main communication with son living abroad."

Table 2: Selection of photos and captions from participant 1

Frequent topics included the value of keeping in touch with family, friends or the local community. The representation of this was often the technology used to communicate such as a mobile phone that was used for calling family members, or a train ticket representing traveling to visit someone, or the actual person themselves depicting how time was spent when they were together. Participants also discussed the common theme of food and drink. Examples included the preference for drinking a cup of tea every morning for "chill out time" or the importance of cooking and organising meal times by showing food that had come out of the oven. Finally, health and wellbeing was a recurring theme which showed the importance of medication routines such as taking pills everyday or the importance of staying active both mentally and physically by being involved in outdoor activities.

Differences emerged between photos related to work and travel. Employed participants discussed how their employment aspirations had influenced where they were based, daily schedule, and ability to keep in touch with dispersed family and friends. For instance, participant 6 took a photo of the train ticket used on her trip from the place where she works to visit her friends. Some student participants who, like the employed, had relocated to attend university and showed photos of studying in multiple locations such as rented accommodation at university, university labs parents home, and sometimes a partners house too. Photos from students often depicted traveling to these separate places of residence such as being on the train from university to home for the weekend or traveling by bike from home to work. In contrast to both, some participants (typically those that were retired) showed less fragmentation in location yet also experienced the same tensions caused by maintaining long distance relationships with dispersed family and friends.

Sorting the photos in order of value caused participants to compare different lifestyle aspects and prioritise which they valued the most. Following this, dividing 100 points between their photos gave each photo a value weighting. Table 3 shows photos that were ranked in the top 3 positions in the sorting, and, the most allocated value points. For the majority (5/6) of participants the photos that were ranked in the top 3 were awarded over half of the points showing how a great proportion of value was associated with few items. Considering these 5 participants the greatest proportion of points were related to photos representing family, home and health and wellbeing. Participant 4 placed great importance on a picture of her husband and pet



cats by awarding 70/100 points to those two photos. Participant 2 placed 70/100 points between three photos representing his parents and home life. Participant 3 divided points between many photos showing equal value for many different aspects of life. Most valued photos included two photos related to health (15 points each), a photo related to education and work (15 points), a photo related to views from home (15 points) and travelling (15 points).

### Group Values and Behaviours (Task 4)

For each participant and each photo Table 6 shows how each photo was categorised. This includes the categorisation task that was completed individually, and subsequently a merged into a final set of categories agreed upon by the group. The final set of categories were: *Community* (to mean family, friends, peers and community members), *Health and Wellbeing*, *Food and Drink*, *Hobbies / Entertainment*, *Home*, *Nature*, *Special Day Event*, *Travel*, *Work*, *Daily Routine* and *Education and Knowledge*.



Table 5: Categorisation tasks

In total 34 individual categories were created and then merged to 11 group categories. Table 6 shows how the individual categories merged together. Five participants had photos within the *Community* and *Home* categories. Three participants had photos within *Health and Wellbeing*, *Hobbies / Entertainment* and *Work*. Two participants had photos within *Nature*, *Special Day Event* and *Daily Routine*. One participant had photos within *Travel* and *Food and Drink*. As mentioned previously, no photos were placed in the *Education and Knowledge* category.

Many photos were related to more than one category, depending on what was depicted in the photograph and what was the underlying value being represented. For instance, participant 5 named an individual category of *appliances and tech* that

contained photos of a mouse and mobile phone. The ultimate purpose of these appliances was to stay connected with colleagues, friends and family so it was subsequently placed in the *Community* category.

The ability for the participants to group the aspects of their lifestyles into the 11 categories shows that despite having a large set of diverse activities and individual categories, all participants shared many higher level values. The commonality in higher-level values has implications for the design of interactive social-media tools as it enables developers to distinguish between and reason about individuals and groups of people according to their values, and allows these values to be used as motivators for behaviour change.

### Tensions, Trade-offs and Energy-use (Task 5 and 6)

Figure 2 shows the cumulative results for participants according to where they would *spend* their energy points and another 12 according to where they would *save* their energy points. Table 4 shows the same results for each participant. The group categories where participants were willing to allocate the most spend points to are *Community*, *Home* and *Health and Wellbeing*. The group categories where participants were willing to allocate the most save points were *Home*, *Special Event* and *Daily Routine*.

In their supporting statements participants revealed why this was the case. If we consider where the most spend points were allocated the result is not surprising as these categories also contain the highest value photos. When considering the large amount of save points allocated to some categories the justifications are different. *Daily Routine* category contained activities of low value such as mundane chores which may reflect a willingness to change this activity (or at least change the way in which it is done). When considering *Special Day Event* this category contained events that occurred infrequently and therefore had less impact on everyday lifestyle compared to regular activities. Participant 6 referred to christmas as being an example of a special events that she would be prepared to change saying that "...it is seasonal, only once a year, the moment has passed."

The *Home* category appeared to be particularly complex as it was allocated high numbers of both spend and save points. It was frequently referred to as one of the highest value aspects of life yet is an area that contains many aspects that participants were willing to change. The photos placed in this category contained both high and low value photos and the spend points were allocated to certain high value aspects, while the save points were allocated to low value aspects. In addition, photos often represent things of high and low importance e.g. participant 6 frequently has (and values highly) cups of tea yet it may not be as important as other aspects of her life, participant 1 frequently performs (and doesn't value highly) household chores yet understands their importance.

Participant	Points (Task 3)	Rank (Task 2)	Individual Category	Group Category	Photo
1	20	1	Family	Community	My Phone
1	15	2	Health and Well being	Health + Wellbeing	Prescribed medicine
1	10	3	I like my food	Food + Drink	Breakfast - Porridge
1	15	6	I like my food	Food + Drink	Evening meal
2	30	1	house and property and landscape	Home	view of my cottage
2	20	2	parents	Community	picture of my mother
2	20	3	parents	Community	picture of my father
3	15	1	Walking and running (health)	Health + Wellbeing	Bath half-marathon
3	15	2	Education and work	Work	Uni
3	15	3	Views from home	Home	View
3	15	5	Travelling	Travel	Cream tea
3	15	6	Walking and running (health)	Health + Wellbeing	Canal
4	50	1	Family / Love	Community	My Best Friend
4	20	2	Family / Love	Community	"Dawn Chorus"
4	15	3	Home / Safe / Comfort	Home	The woodstove, with suppers
5	50	1	Family (keeping in touch)	Community	photo - family + friends
5	15	4	Local services	Health + Wellbeing	NHS exemption cert
5	10	2	Natural world	Special Day Event	fresh flowers
5	10	3	Natural world	Nature	sunshine
6	20	1	Communication / Family / Friends	Community	Mobile phone
6	20	2	Communication / Family / Friends	Community	Train ticket
6	15	6	Daily routine	Daily Routine	Cup of tea
6	10	3	Hobby	Hobbies	Leaves (photograph)

Table 3: Most valued photos (Tasks 2 and 3).

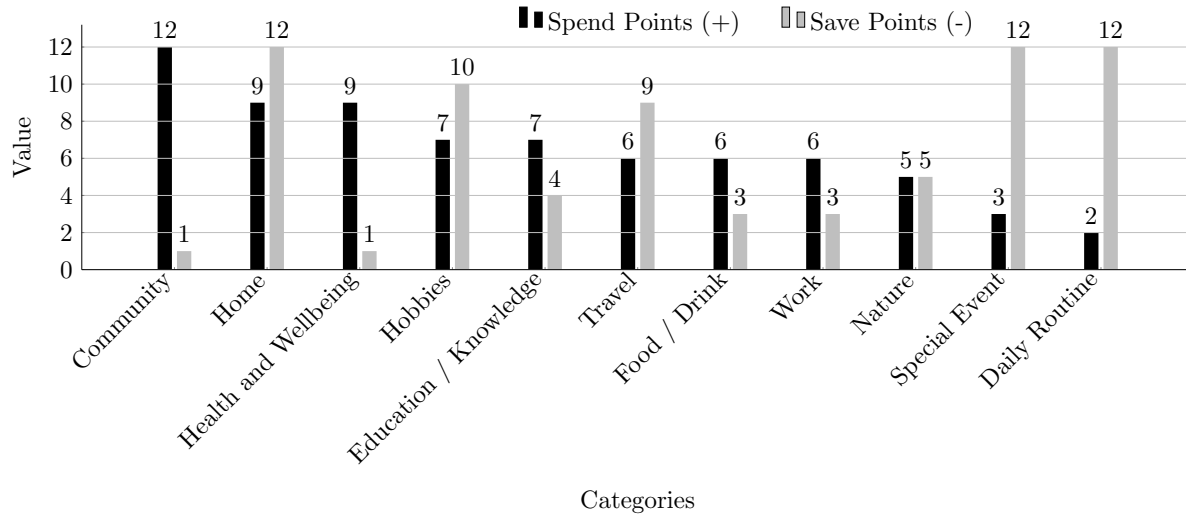


Figure 2: Energy points spent and saved across all categories. Cumulative. (Tasks 5 and 6)

Participant	Comm-unity		Home		Health Wellbeing		Hobbies		Education Knowledge		Travel		Food Drink		Work		Nature		Special Event		Daily Routine	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
1	3		2	3	1		2	2	1	1	1	1	1	1			1		2		2	
2	1	1	1	1	1	1	1	2		1	1	1	1		2	1	1	2	1	1	2	1
3	2		1	2	2		1	3	1		1	2	2		1	1	1	1		1		2
4	2		2	1	2		1	1	2		2		1	1			1	2	1	3		2
5	2		2	2	2			1	2	1	1	2			2		1		3		3	
6	2		1	3	1		2	1	1	1	2	1	1	1	1	1			1	2		2

Table 4: Energy points spent and saved for each participant across all group categories. (Tasks 5 and 6).



Group Category	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
<b>Community</b>	<b>Family</b> {My Phone; School Bags; Flowers}	<b>Parents</b> {Picture of my Father; Picture of Mother}		<b>Family / Love</b> {“Dawn Chorus”; My best friend}	<b>Family (keeping in touch)</b> {Family and Friends}	<b>Communication / Family / Friends</b> {Train ticket; Mobile}
				<b>Social activity</b> {masked ball}	<b>Local Services</b> {Community handbook}	
					<b>Appliances / Tech.</b> {Mouse; Mobile}	
<b>Health and Wellbeing</b>	<b>Health and Wellbeing</b> {Prescribed Medicine; Keep fit class; Crosswords}		<b>Walking Running (health)</b> {Canal; half-marathon; Footpath along river; A walk}		<b>Local services</b> {NHS Exemption Cert}	
<b>Food and Drink</b>	<b>I like my food</b> {Evening Meal; Porridge}					
<b>Hobbies / Entertainment</b>				<b>Self-expression</b> {work-in-progress}	<b>Knowledge / Memories</b> {Books}	<b>Bristol Life</b> {Jungle Rumble Adventure Golf}
				<b>Social activity</b> { Glass Class; Theatre Royale}	<b>Appliances / Tech.</b> {Michael Jackson Collection}	<b>Hobby</b> {Leaves (photography)}
<b>Home</b>		<b>House / Property / Landscape</b> {View; My Cottage; My plantation; Log Shed;}	<b>Views from home</b> {View, View}	<b>Home / Safe / Comfort</b> {The woodstove with suppers; winter scarves; In garden with tea}	<b>Appliances / Tech.</b> {Modern Appliance}	<b>Bristol Life</b> {Graffiti}
		<b>House Contents</b> {Shiraz Carpet; Painting}				
<b>Nature</b>				<b>Nature and my place in it</b> {Somerset Levels}	<b>Natural world</b> {Sunshine}	
<b>Special Day Event</b>					<b>Natural world</b> {Fresh Flowers}	<b>Xmas / Seasonal</b> {Soup Book; Xmas Tree}
<b>Travel</b>			<b>Travelling</b> {Cream Tea; Tea Room; The Bridge BOA}			
<b>Work</b>		<b>Careers</b> {Telephone; Film Extras}	<b>Education and work</b> {Uni}			<b>Work</b> {Uni; Card Reader}
<b>Daily Routine</b>	<b>Mundane Chores</b> {Washing; Shop}					<b>Daily Routine</b> {Cup of Tea}

<sup>a</sup> Categories shown in bold, the photos within them in brackets. e.g. **Category**{photo 1; photo 2}

<sup>a</sup> Blue shaded categories contain top value photos (see Table 3)

Table 6: Categorisation of Photos<sup>a</sup>

Participants distributed their spend points much more evenly across the group categories after the group discussions about common categories than in Task 3 where they distributed 100 value points between their own photos individually. As mentioned previously, for the majority of participants value was weighted heavily upon a small group of photos. However, in Task 5 and 6 we can see from Table 4 and 2 that each participant awards similar points spread across 7-10 of the 11 group categories. This shows the influence that the group categories had upon individual attitudes. Each participant found value within new group categories that did not contain their photos. An example of this can be demonstrated with participant 2.

Initially his photos fell within three of the group categories with 70/100 points awarded to 3 photos within 2 group categories. When considering Task 5 we can see that the same participant awarded points among 10 of the 11 group categories with either 1 or 2 points awarded in each. This shows that the group or community values exert influence on the individuals behaviours through their recognition and acceptance of those values. Each participant found value within new group categories that did not contain their photos. An example of this can be demonstrated with participant 2. Initially his photos fell within three of the group categories with 70/100 points awarded to 3 photos within 2 group categories. When considering Task 5 we can see that the same participant awarded points among 10 of the 11 group categories with either 1 or 2 points awarded in each. This convergence of value between members of the group and indicates that the group categories also had influence upon how individuals prioritised valued aspects of their own lifestyle.

#### *Relating Values and Behaviours to Energy Use*

When discussing the impact that participants' current lifestyles had upon energy use they were aware of many activities within the home environment that had direct impact on energy use such as showering, cleaning, appliance use, or cooking. These activities were indirectly dependent on others. Cooking within the home requires someone to travel to buy the food etc. Other areas of energy consumption discussed included the impact of social activities, education, hobbies, and work. These activities happened in locations other than the home where there were additional tensions about the way they were carried out. For instance working from home is a possibility yet for most people it is not an option, some employees don't allow it and it is disadvantageous when working in a team.

Participants discussed current energy saving activities. Typically, a priority was given to changes that did not have negative impacts on aspect of their life that were high value. In fact, the changes that were made cost the least. Cost was referred to as to the effort needed to make the change, time invested, negative impact on most valuable aspects of lifestyle, or monetary. Participant 1 enjoyed cooking but also reduced energy-use related to this activity by cooking in batches. This change reduces energy consumption yet allows the high value activity of cooking to be supported and saves time as many meals are prepared together.

#### *Preference to change low value activities that had alternatives*

Participants also showed a preference to change some of the lower value aspects of their life as opposed to the higher value

aspects. For many, this involved cutting down activities related to hobbies and entertainment as they "weren't necessary" and there were many alternatives that did not use as much energy. Participant 4 mentioned how she would enjoy 'more nature walks' or "doing things close by" as opposed to traveling to go to the theatre or substantially further for holidays abroad.

Participants are the least likely to give up high value activities. As just stated, participants who had already made changes to the high value activities had often found an alternative way of performing the activity without constraining the value. As a result, when a high value activity is in danger of being constrained, participants were prepared to invest effort into finding alternatives. As an example, participant 2 placed the most value in photos within the *Home* category with many photos depicting his cottage and the surrounding areas. He invested in renewable energy supplier to ensure that the energy used within his home came from environmentally friendly sources. He was also impressed as the company was "ethically excellent". Many trade-offs were made in this decision to reduce CO2 footprint. This included the increased cost of electricity and time spent to change suppliers against the alternative cost of changing the way in which activities were performed within the house so that less energy was used. In this circumstance, the cost of changing his current way of life at home was high influencing his decision to make an effort with the alternative option of changing to a renewable energy supplier.

#### *Changes to society*

Participant 4 mentioned that a change of mentality to "mend and make do" was required to reduce consumption by fixing belongings instead of buying new. She also mentioned how people would be more willing if large scale changes were "if we did it en masse it would make a difference". Participant 1 noted how in the future society may need to "think locally [...] we all used to stay around villages" discussing how in the future we may revert back to ways we used to live in the past where everyday resources are nearby connections within members of the local community were stronger. Hence we can see the individual identifying where they need help or where they might draw upon larger societal values to make changes to their own behaviours.

### **IMPLICATIONS FOR TOOL DESIGN**

In designing interactive and social-media technologies it is important to use knowledge about the users values, the communities values and societys values to influence appropriate behaviour changes that are appropriate, to understand how these change can be motivated, and to know how this influence is best communicated to a user.

The way behaviour change is framed is important. A popular strategy used by existing tools is to motivate energy efficient behaviour by using representations of nature, or of money saved. These representations hope that an understanding about the impact of our behaviour upon nature or finances, will cause a reduction in energy-use. However, users make trade-offs between a much larger number of aspects of their lifestyles when making decisions about energy-use. This study demonstrate how 11 groups of values influence behaviour and consequently

could be used as additional ways to understand and motivate behaviour change.

There is a mismatch between the way we make decisions about energy and the way in which information is presented to us in order to facilitate such decisions. When making decisions about behaviour change, participants considered alternatives that were possible and ultimately the impact the changes would have upon the most valued aspects of their lifestyle. Changes to lower valued activities were prioritised before higher valued activities. Also, people considered the amount of effort needed to change to a different way of doing things relative to its associated lifestyle values. If persuasive technologies aim to curtail all energy use behaviour without understanding these trade-offs that are being made or consequences on the valued aspects of an individuals lifestyle they are in serious danger of forcing changes that are neither relevant nor appropriately motivated.

Targeting groups of people can take advantage of affects of social influence. Despite this, a recent survey [8] indicated that the majority of persuasive technologies are designed to interact with an individual as opposed to groups of people. Results reveal signs of social influence from 6 participants within the focus group related to decisions on where to spend and save energy. When participants were discussing their own photos, most value was allocated to a small number of photos. In contrast, when discussing group categories, points relating the spending and saving energy were distributed across more categories.

## CONCLUSIONS

This paper provides a set of principles for using peoples values to influence their behaviours and an architecture for applying those principles to designing interactive and social-media technologies to influence and support behaviour change.

We have shown through the diary and focus group study that people and groups identify the relationships between their individual and community and societal values and their own and motivations to change their behaviours.

We also discuss implications for the design of interactive and social media technologies to influence people's decisions and behaviours. In particular, it is important take into account overlooked user information (user values, user activities, physical context, social context and motivation context) and methods of influence (individual, community and societal) that are pivotal to the success of behaviour change interventions.

## ACKNOWLEDGEMENT

The work reported in this paper is funded by the Engineering and Physical Sciences Research Council (EPSRC) under the Transforming Energy Demand in Buildings through Digital Innovation (TEDDI) (grant reference EP/K002465/1).

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